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NOTES ON GEOGRAPHIC DISTRIBUTON

First record of Double-lined Mackerel, *Grammatorcynus bilineatus* (Rüppell, 1836) (Scombriformes, Scombridae) from Peninsular Malaysia

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Abstract. Three individuals of *Grammatorcynus bilineatus* (Rüppell, 1836), Double-lined Mackerel, were recorded in local fish market in Terengganu, Malaysia. Although in Malaysia *G. bilineatus* previously has been recorded from East Malaysia, the species has not been recorded from Peninsular Malaysia. Therefore, the specimens described herein represents the first record of *G. bilineatus* from Peninsular Malaysia. Detailed morphometric and meristic data are presented along with brief diagnostic characters.

Key words. Distribution, marine fish, new record, range extension, South China Sea

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INTRODUCTION

Double-lined Mackerel, *Grammatorcynus bilineatus* (Rüppell, 1836), is one of two species of *Grammatorcynus* Gill, 1862 (Scombriformes, family Scombridae). It has a wide distribution spanning from the Red Sea to Andaman Sea in Indian Ocean, and from the Ryukyu Islands to the northern coast of Australia, including Marshall Islands and Fiji in Western Pacific (Lheknim 2019). Therefore, its geographical distribution spans the tropical and sub-tropical areas of the Indian and Pacific oceans from 30–20°S and from 030–180°E. This subtropical reef-associated fish species is usually found in shallow waters at depths of 15–50 m, where it either forms groups with other scombrids or is solitary (Froese and Pauly 2023).

Grammatorcynus bilineatus in the Malay language among fishermen is locally known as "Aya Dua Garis" (Lim et al. 2018) or "Kembung Tenggiri". In Malaysia, this species has been recorded in only East Malaysia (or Malaysian Borneo) (GBIF 2023). A single occurrence was reported in Sabah based on human observation near Pulau Pom Pom, while the remaining three specimens were collected from a fish landing site in Semporna, facing the Celebes Sea and deposited in the collection of the Universiti Sains Malaysia. However, *G. bilineatus* has never been recorded from Peninsular Malaysia (or West Malaysia). Here, we provide a record of *G. bilineatus* collected at Terengganu water, which represents the first record of this species from Peninsular Malaysia, South China Sea.

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METHODS

Specimens of *Grammatorcynus bilineatus* were collected from a local fish market in Kuala Nerus, Terengganu, Malaysia. These specimens were caught by hook-and-line off Pulau Karah, Terengganu by local fishermen. We collected and fixed the specimens following the procedure of Motomura and Ishikawa (2013). Measurements and terminology follow Collette and Gillis (1992). The specimens were measured to the nearest 0.01 mm using Vernier calipers. Morphometric measurements, including total length (**TL**), fork length (**FL**) and standard length (**SL**), are in millimeters, while other measurements are expressed as a percentage of either fork length or head length. The species was identified following Collette and Gillis (1992). The specimens were deposited at the South China Sea Repository and Reference Center, Universiti Malaysia Terengganu, Malaysia (**UMTF**).

RESULTS

Order Scombriformes
Family Scombridae Rafinesque, 1815
Genus *Grammatorcynus* Gill, 1862

***Grammatorcynus bilineatus* (Rüppell, 1836)**
Figure 1, Table 1
Thynnus bilineatus Rüppell 1836: 39, pl. 12 fig. 2 (type locality: Massawa, Eritrea, Red Sea)

New record. MALAYSIA – **Terengganu** • Kuala Nerus; 05°26′24.57″N, 103°03′26.65″E; 20.VII.2022; Mat Jaafar TNA leg.; hook and line; 3 spec., ♂, 213.0–264.0 mm SL; UMTF 10391 (Figure 1b), UMTF 10392 (Figure 1a), UMTF 10393.

Identification. *Grammatorcynus bilineatus* can be distinguished from *G. bicarinatus* Collette in Carpenter & Niem, 2000, (Shark Mackerel) by combination of the following characters: more gill rakers (18–24; 12–15 in *G. bicarinatus*), larger eye size (4.0–6.0% FL, vs. 3.1–4.6% in *G. bicarinatus*), and smaller maximum size (600 mm FL vs. 1100 mm in *G. bicarinatus*) (Collette and Gillis 1992). Other useful morphological features for identification are the elongate and slightly compressed body, which is covered by moderately small, cycloid scales. The mouth is relatively small, and the jaws have slender, conical teeth on vomer, palatines, and upper surface of broad tongue. The upper jaw reaches to about the middle of the eye. Two dorsal fins are separated by a short space and are followed by finlets. The pectoral fins are rather short. The caudal fin is deeply forked and with three caudal keels; one of these keels is not very prominent and covered with a row of pored scales, and the other two keels at the base of the caudal fin are much smaller. Two lateral lines are present; the upper originates from the dorsal part of the operculum and runs along the upper half of the body to almost anterior to the median caudal keel, and the lower lateral line branches off from a point below the third dorsal spinethen descends to lower half of the body; this lower lateral line re-joins the upper lateral line at the base of the caudal fin. The body color is metallic bluishgreen on the back and upper sides, silvery on the lower sides, and silvery white without black spots on the belly. Detailed morphometric measurements and meristic counts are provided in Table 1.

DISCUSSION

Our specimen agrees with the original description of *Grammatorcynus bilineatus*. Before 1983, *G. bilineatus* was sometimes confused with *G. bicarinatus*. Collette (1983) and Collette and Nauen (1983) demonstrated that *G. bilineatus* can be morphologically distinguished from the only other *Grammatorcynus* species, *G. bicarinatus*. The latter species is restricted to the waters of northern Australia and southern New Guinea. Collette and Gillis (1992) later gave osteological evidence that confirm the separation of these *Grammatorcynus* species.

The presence of *G. bilineatus* in Peninsular Malaysia was anticipated, given its widespread distribution near coral reefs in the Indo-West Pacific (Collette and Gillis 1992). Furthermore, the coastal waters off Pulau Karah, Terengganu, are known for their abundant coral reefs and associated sandy bottoms. *Grammatorcynus bilineatus* is rare in Malaysian waters. Previously, it has been documented only in the Celebes Sea of East Malaysia. Our new record extends the known geographic range of *G. bilineatus* to Peninsular Malaysia

Figure 1. *Grammatorcynus bilineatus*, Kuala Nerus, Terengganu, Malaysia. **a.** Fresh specimen, UMTF 10392, 264 mm SL. **b.** Preserved specimen, UMTF 10391, 252 mm SL.

Table 1. Morphometric measurements and meristic counts of *G. bilineatus* collected from Kuala Nerus, Terengganu.

Character	Present study			Mean	SD	Collette and Gillis (1992)
	UMTF 10391	UMTF 10392	UMTF 10393			
Total length (mm)	319.0	338.0	260.0	305.7	40.7	—
Fork length (mm)	264.0	278.0	225.0	255.7	27.5	226-575
Standard length (mm)	252.0	264.0	213.0	243.0	26.7	—
As % of fork length						
Snout–anal fin	60.2	60.8	61.4	60.8	0.6	58.1–64.1
Snout–2nd dorsal fin	56.2	55.6	54.4	55.4	0.9	52.8–61.9
Snout–1st dorsal fin	31.0	31.1	30.5	30.9	0.3	27.6–32.2
Snout–pelvic fin	25.7	25.6	26.3	25.8	0.4	23.6–30.6
Snout–pectoral fin	22.7	22.7	23.7	23.0	0.6	19.9–24.5
Pectoral fin–pelvic fin	11.4	10.8	12.5	11.6	0.8	9.0–11.1
Head length	22.0	22.1	22.7	22.2	0.4	19.7–23.6
Max body depth	21.8	21.5	22.0	21.7	0.2	16.4–23.4
Max body width	12.7	12.7	12.6	12.7	0.1	9.1–13.6
Pectoral fin length	12.5	12.8	7.6	11.0	2.9	10.6–14.2
Pelvic fin length	7.7	7.3	7.2	7.4	0.3	7.0–8.7
Pelvic fin insertion–vent	30.7	32.8	33.7	32.4	1.5	26.2–35.4
Pelvic fin tip–vent	24.7	25.9	26.8	25.8	1.1	22.8–27.3
1st dorsal fin base	22.3	20.4	22.2	21.6	1.1	21.1–26.1
2nd dorsal fin height	9.4	10.1	8.9	9.5	0.6	8.8–11.6
2nd dorsal fin base	10.8	10.3	10.7	10.6	0.3	7.9–11.8
Anal fin height	8.3	9.5	7.2	8.3	1.1	8.2–11.4
Anal fin base	8.8	9.2	8.9	8.9	0.2	7.3–10.1
Snout (fleshy)	7.5	7.1	7.2	7.2	0.2	5.8–9.0
Snout (bony)	8.0	7.7	7.7	7.8	0.2	6.0–8.0
Maxilla length	9.8	10.1	10.4	10.1	0.3	8.9–10.7
Postorbital	8.5	9.5	9.5	9.2	0.6	7.8–9.8
Orbit (fleshy)	5.0	4.5	5.4	5.0	0.5	4.0–6.0
Orbit (bony)	4.9	5.1	6.1	5.3	0.6	5.3–8.8
Interorbital	7.1	7.3	7.6	7.3	0.2	5.6–7.4
2nd dorsal fin –caudal	42.5	40.7	41.3	41.5	0.9	42.7–49.6
As % of head length						
Snout (fleshy)	34.1	32.0	31.5	32.5	1.4	24.8–39.7
Snout (bony)	36.4	34.9	34.1	35.1	1.2	28.1–35.7
Maxilla length	44.8	45.8	45.6	45.4	0.5	42.0–48.0
Postorbital	38.6	43.1	41.9	41.2	2.3	35.0–45.0
Orbit (fleshy)	22.9	20.4	23.9	22.4	1.8	19.1–25.7
Orbit (bony)	22.4	23.2	26.4	24.0	2.1	25.2–38.1
Interorbit	32.4	33.3	33.3	33.0	0.5	25.3–32.7
Counts				Modes		
Dorsal fin spines	XII	XII	XII	XII	0.0	XI–XIII (XII)
Dorsal fin rays	10	10	11	10	0.6	10–12 (11)
Dorsal finlets	6	6	6	6	0.0	6–7 (6)
Anal fin soft rays	11	11	10	11	0.6	11–13 (12)
Anal finlets	6	7	6	6	0.6	5–7 (6)
Pectoral fin rays	24	24	24	24	0.0	22–26 (24-25)
Pelvic fin rays	5	5	5	5	0.0	—
Gill rakers						
Upper	5	6	6	6	0.6	—
Lower	15	15	16	15	0.6	—
Total	20	21	22	21	1.0	18–24 (21)

and the southern South China Sea (Figure 2). The emergence and expansion of *G. bilineatus* to Peninsular Malaysia may have been caused by natural displacement as well as by changes in oceanographic conditions.

Current knowledge of fish species inhabiting the continental shelf of Malaysia remains limited (Chong et al. 2010). In the past five years, scientific papers and books have revealed interesting discoveries, including 31 species newly reported from the east coast of Peninsular Malaysia (Mat Jaafar et al. 2019; Okamoto et al. 2019; Motomura et al. 2021; Seah et al. 2020, 2021; Yusuf et al. 2021; Mohd Nur et al. 2022; Mat Piah et al. 2023). Further exploration of Malaysia's marine fishes will contribute valuable data to enhance the understanding of Malaysia's biodiversity.

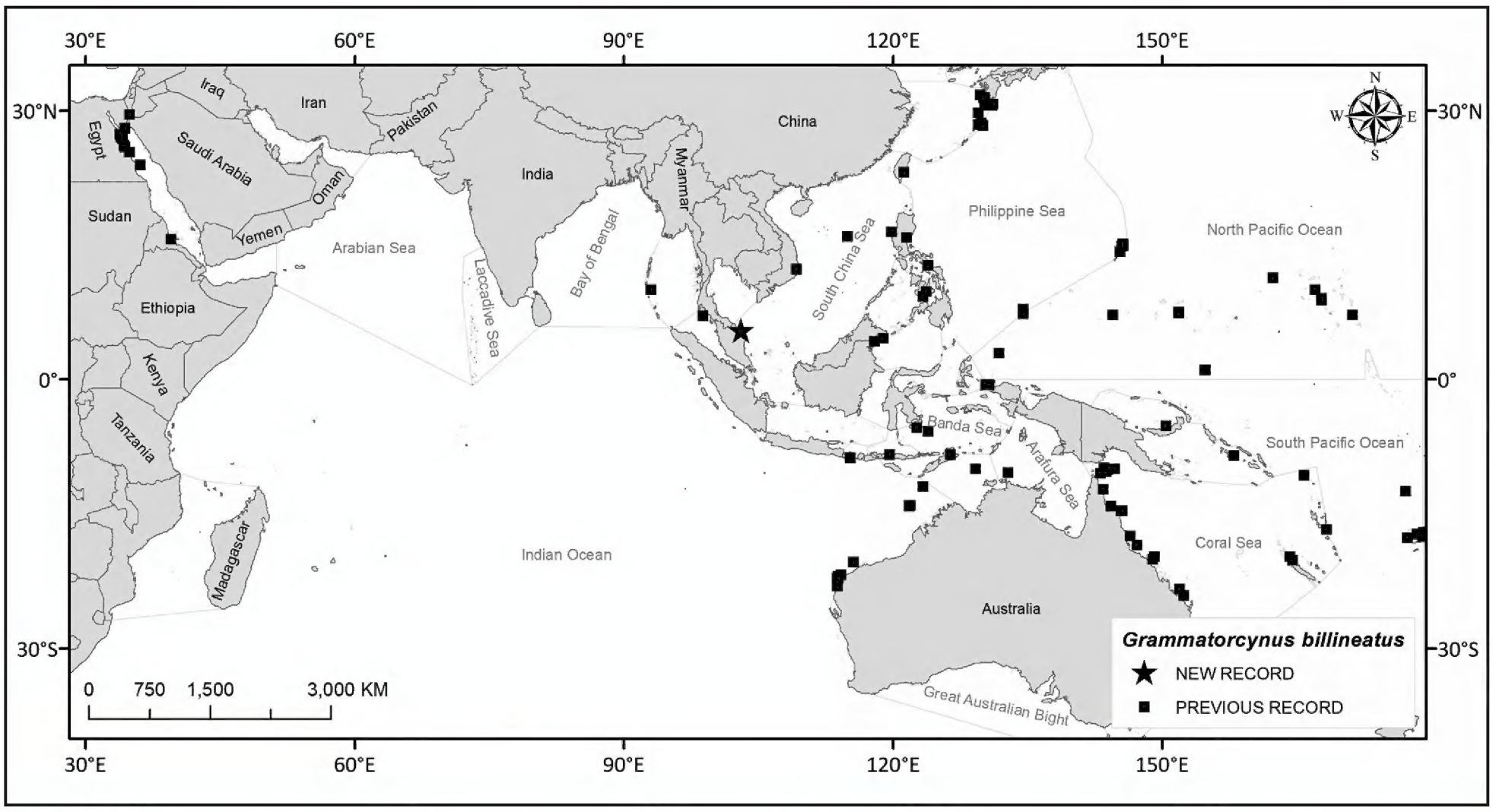

Figure 2. Map of records of *Grammatorcynus bilineatus* in the Indo-West Pacific Ocean: square = previous records; star = new record from the east coast of Peninsular Malaysia.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: YGS, TNAMJ. Formal analysis: YGS. Funding acquisition: YGS. Investigation: YGS, TNAMJ. Methodology: MSA, SAMP. Validation: YGS, MSA. Writing – original draft: TNAMJ. Visualization: MSA. Writing – review and editing: YGS, MSA, SAMP, TNAMJ.

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